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7278 7590 04/17/2008

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EXAMINER	
HANOR, SERENA L	
ART UNIT	PAPER NUMBER
1793	

DATE MAILED: 04/17/2008

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/811,505	03/26/2004	Gerald D. Surender	03108/0201073-US0	8917

TITLE OF INVENTION: SYNTHESIS OF ULTRAFINE RUTILE PHASE TITANIUM DIOXIDE PARTICLES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1440	$300	$0	$1740	07/17/2008

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
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INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

7278 7590 04/17/2008

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Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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nonprovisional	NO	$1440	$300	$0	$1740	07/17/2008

EXAMINER	ART UNIT	CLASS-SUBCLASS
HANOR, SERENA L	1793	423-614000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:

❑ Issue Fee

❑ Publication Fee (No small entity discount permitted)

❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**

❑ A check is enclosed.

❑ Payment by credit card. Form PTO-2038 is attached.

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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DATE MAILED: 04/17/2008

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)

(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 771 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 771 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Notice of Allowability	Application No.	Applicant(s)	
	10/811,505	SURENDER ET AL.	
	Examiner	Art Unit	
	SERENA L. HANOR	1793	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *Amendments and Remarks dated 02/06/2008*.

2. ☒ The allowed claim(s) is/are *1, 3-21*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

/Timothy C Vanoy/
Primary Examiner, Art Unit 1793

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Mr. Jonathon Harris on 04/14/2008.The application has been amended as follows: In claim 16 line 1, please replace "1" with --15--.

REASONS FOR ALLOWANCE

The following is an examiner's statement of reasons for allowance:

i. Cortesi et al. (U.S. Patent No. 4,574,078) discloses an inert gas stream containing an aerosol of titanium tetrachloride being mixed with a cold inert gas stream such as air or nitrogen in order to hydrolyze said titanium tetrachloride to yield titanium dioxide (col. 2 lines 3-15, lines 25-26, line 46). The titanium tetrachloride aerosol is formed using a nebulizer in which an inert gas such as air or nitrogen is bubbled through the liquid titanium tetrachloride (col. 2 lines 31-34). Steam, i.e. water, can be introduced in a third gas stream consisting of air or nitrogen, which is bubbled through said steam to form an aerosol that is then heated to evaporate the water (col. 3 lines 20-25). Amounts of steam (i.e. water) corresponding to 1.5-12 times the stoichiometric ratio of the hydrolysis reaction are used (col. 3 lines 46-50). The particles are dried and

then calcined at a temperature of 540-580°C to obtain anatase titanium dioxide particles (col. 3 lines 65-68). Examples 5 and 6 disclose the use of n-propyl alcohol (i.e. propanol) and isobutyl alcohol, respectively, to dilute (i.e. dope) the initial metal compound (col. 6 lines 44-47, col. 7 lines 31-34). The ultimate particle sizes after calcination are greatly reduced in Examples 5 and 6, 260 and 220 nm respectively, compared to Examples 1-4, 690-940 nm (col. 5-7).

Cortesi et al. does not disclose the crystal type of the pre-calcined particles, the post-calcined particles are anatase instead of rutile, and the calcination temperature is higher than that of claim 1 of the instant invention.

ii. Pratsinis et al. (U.S. Patent No. 5,698,177) discloses a process for preparing titanium dioxide powder by the oxidation/hydrolysis of mixing vapor phase $TiCl_4$ and O_2 in a laminar diffusion flame reactor (i.e. aerosol reactor), externally heating said mixture in said reaction area, and collecting the titanium dioxide powder formed (col. 3 lines 35-41, lines 64-65, col. 4 lines 39). A dopant may be added to the reaction mixture in the reaction area to affect the properties of the titanium dioxide produced (col. 3 lines 44-47, col. 5 lines 46-49). In a laminar diffusion flame reactor fuel is fed into the reactor in a sleeve which completely surrounds the reactants being fed into the reactor to heat the reactor by combustion (col. 6 lines 37-41). The presence of water vapor, which is formed in situ in the reaction area during the combustion process, promotes the formation of anatase phase titanium dioxide product (col. 6 lines 63-67, col. 7 lines 1-4). The laminar diffusion flame reactor generally consists of 5 concentric quartz tubes, but

the number of concentric tubes in the reactor and their size can be varied depending upon the requirements of the particular reaction (col. 4 lines 39-44). The argon gas/$TiCl_4$ vapor is directed through the center tube with a flow rate of 100-300 cm^3/min (col. 5 lines 1-2). The subsequent concentration of $TiCl_4$ vapor in the reaction area is $7x10^{-5}$ - $1x10^{-2}$ mol/min, as determined by the flow rate (col. 5 lines 3-8). The O2 is directed into the tube immediately adjacent the center tube with the argon gas/TiCl4 vapor mixture with a flow rate of 0.3-5.5 l/min (300-5500 cm^3/min) (col. 5 lines 33-39). Vapor phase $TiCl_4$ is formed by bubbling an inert gas such as argon through liquid $TiCl_4$ (col. 3 lines 47-50).

Pratsinis et al. discloses using a feed of O_2 and the in-situ formation of water vapor instead of using a feed of water vapor. Also, a laminar diffusion flame reactor is employed, which would utilize a much higher hydrolysis reaction temperature than that of claim 21, 80-137°C, and there is no final step of calcination.

iii. Haber et al. (U.S. Patent No. 1,931,380) discloses a process for the production of titanium dioxide from vaporized titanium tetrachloride in the presence of steam or water vapor under the action of heat (lines 33-38). Air is bubbled through liquid titanium tetrachloride to produce a titanium tetrachloride vapor and also bubbled through water to produce a water vapor (lines 64-72). The TiCl4 vapor and the steam are introduced separately into a reaction space that is heated to a temperature for effecting the desired splitting reaction (lines 39-46). The volumetric ratio of steam to TiCl4 is 10:1 (lines 78-

83). The reaction vessel is externally heated to 300-500°C (lines 75-77, lines 87-90). The titanium dioxide product is calcined to form a powder (lines 58-61).

Haber et al. does not disclose the use of a dopant, the crystal type of the particles, or a calcination temperature or time.

iv. Matijevic et al. (U.S. Patent No. 4,241,042) discloses a process for the production of titanium dioxide. A liquid aerosol comprising liquid titanium tetrachloride is contacted with water vapor to hydrolyze the liquid titanium tetrachloride to titanium dioxide particles, and the particles are recovered (col. 2 lines 16-, line 52). The titanium dioxide particles have an average diameter of 50-3000 nm (col. 2 lines 27-31). The aerosol is produced by nebulization, wherein a carrier gas such as nitrogen, helium, or air are bubbled through liquid titanium tetrachloride (col. 2 lines 62-68, col. 3 lines 29-33). An inert gas stream saturated with water vapor is injected into the liquid aerosol stream comprising the carrier gas and vapor TiCl4 (col. 6 lines 15-27).
Matijevic et al. does not disclose the use of a dopant or an aerosol reactor comprising a 3-tube concentric jet assembly.

v. Xia et al. (Low temperature vapor-phase preparation of TiO2 nanopowders) discloses the hydrolysis of TiCl4 to yield TiO2 powder (p. 3505 col. 2). However, it does not disclose the use of a dopant, i.e. the reactor is only made of two concentric tubes, or the prevention of thermophoresis (p. 3506 col. 2). A hydrolysis temperature of 260-525°C yields a particle diameter of 18-120 nm (p. 3507 col. 2).

vi. Ahonen et al. (Aerosol synthesis of Ti-O powders via in-droplet hydrolysis of titanium alkoxide) discloses the calcination of the collected titanium dioxide powders at 500°C for 1 hour to yield the anatase form (p. 115 col. 1, p. 118 col. 2). This calcination temperature is higher than that of the instant invention in claim 1, 150-400°C.

vii. Rubio et al. (Preparation of nanometric titanium hydrous oxide particles by vapour phase hydrolysis of titanium tetrabutoxide) discloses the calcination of the collected titanium dioxide at 1000°C for 1 hour (p. 3399 col. 1). This calcination temperature is higher than that of the instant invention in claim 1, 150-400°C.

viii. Wegner et al. (Nozzle-Quenching Process for Controlled Flame Synthesis of Titania Nanoparticles) does not disclose the use of a dopant in one of its three concentric tubes (p. 1668 col. 1). Instead, methane and oxygen are employed. Also, the resulting anatase titanium dioxide particles are not calcined to form rutile particles.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled “Comments on Statement of Reasons for Allowance.”

CONCLUSION

Claim 16 has been corrected by an Examiner's Amendment to change the dependency to claim 15.

Claims 1 and 3-21 are allowed

Any inquiry concerning this communication or earlier communications from the examiner should be directed to SERENA L. HANOR whose telephone number is (571)270-3593. The examiner can normally be reached on Monday - Thursday 8:00 AM - 5:30 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley Silverman can be reached on (571) 272-1358. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

SLH

/Timothy C Vanoy/
Primary Examiner, Art Unit 1793